

(12) UK Patent Application (19) GB (11) 2 205 153<sup>(13)</sup> A  
(43) Application published 30 Nov 1988

(21) Application No 8812169

(22) Date of filing 23 May 1988

(30) Priority data  
(31) 8712255 (32) 23 May 1987 (33) GB

(71) Applicant  
Goricon Metallurgical Services Limited  
(Incorporated in United Kingdom)  
Picton Street, Kenfig Hill, Bridgend, Glamorgan

(72) Inventor  
Richard John Browning

(74) Agent and/or Address for Service  
Wynne-Jones Laine & James  
Morgan Arcade Chambers, 33 St Mary Street,  
Cardiff, CF1 2AB

(51) INT CL<sup>4</sup>  
C21C 5/46

(52) Domestic classification (Edition J):  
F4B 126 GN

(56) Documents cited  
GB A 2188132 EP A1 0094241 US 4494734  
US 4462574  
Note: US 4462574 and EP A1 0094241 are equivalent;

(58) Field of search  
F4B  
Selected US specifications from IPC sub-classes  
C21C F27D

(54) Improvements relating to plug members for steel furnaces

(57) A plug member for holding back slag during the drawing-off of steel from a furnace provided with a tap hole, comprises a tapered body leading from a top face 1 to a smaller lower face 2 and defining a number of side faces 4 so that when the plug member fits into the tap hole (indicated by the dashed outline 3) small passageways are defined between the faces 4 and the wall defining the hole 3. These allow the molten steel to run off at a slow rate when the furnace has nearly been emptied so that the operator can control the moment at which emptying ceases, so that little or no slag is allowed to run off. Various alternative cross-sectional shapes of the tapered body are disclosed.

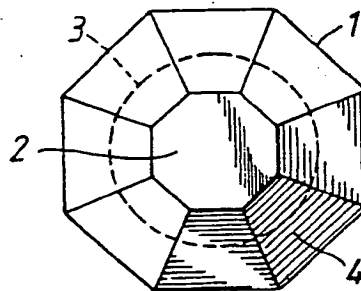


FIG.2.

GB 2 205 153 A

1/2

2205152

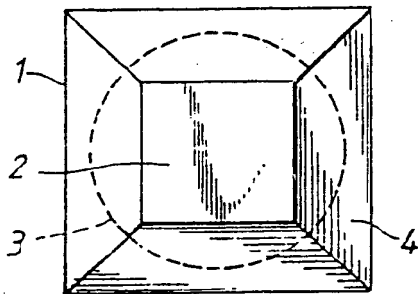


FIG. 1.

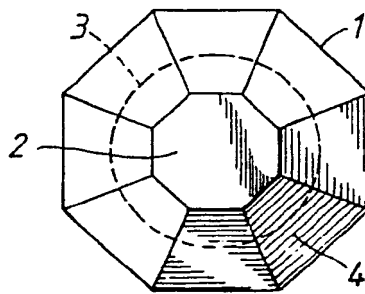


FIG. 2.

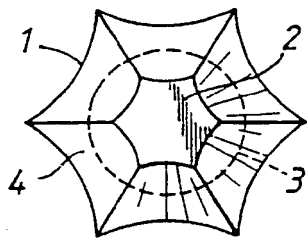


FIG. 3.

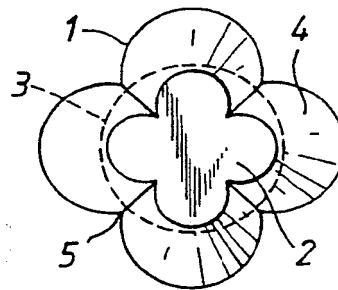


FIG. 4.

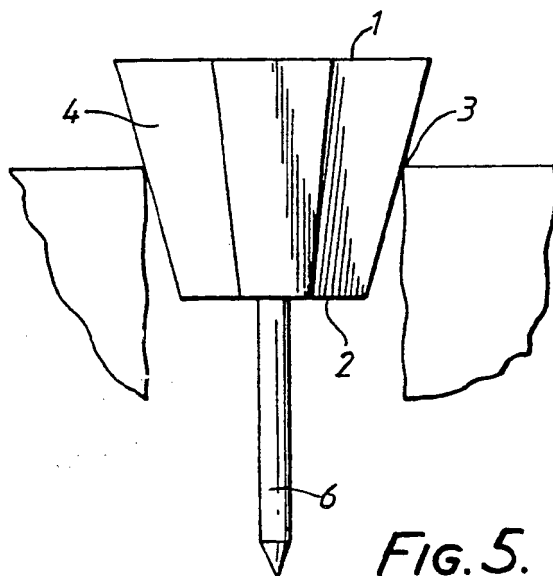


FIG. 5.

2/2

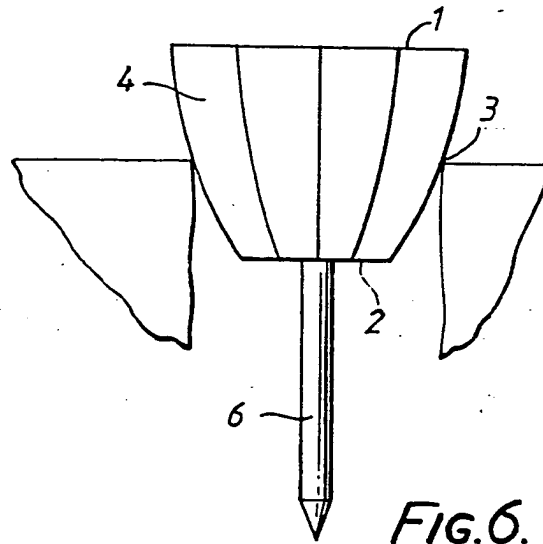


FIG. 6.

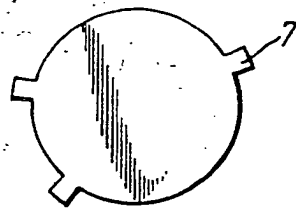


FIG. 7.

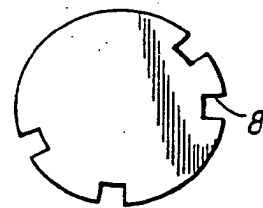


FIG. 8.

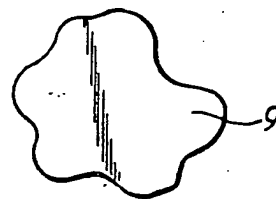


FIG. 9.

"Improvements relating to plug members  
for steel furnaces"

This invention relates to steel furnaces of the form designated referred to by the term "tap-off convertor", namely a convertor which can be tilted so that molten metal therein is able to be drawn off through a tap hole.

The operator needs to know when slag is about to flow, or has started, to flow through the tap hole so that pouring of the steel can be caused to cease. A conventional method of doing this employs a plug member whose specific gravity is less than that of the steel but greater than that of the slag so that the plug member tends to "float" at the interface between the molten steel and slag. The plug member, when suitably positioned, will then close off the tap hole, at least partially, as the slag layer approaches the tap hole. What happens, in effect, is that the flow of material through the tap hole is substantially reduced as the plug member covers over or enters the tap hole. This enables the operator to allow most of the residual pool of molten steel to run off until such time as the slag itself starts to run off, whereupon the convertor can be tipped back again to retain the rest of the slag.

However, if the tap hole is newly formed it will

not have eroded to any great extent during an initial number of steel forming operations, with the result that the plug member may seal off the tap hole too well, thus preventing run off of the residual pool of molten steel as the final step. It is an object of this invention to alleviate this particular difficulty.

Accordingly this invention provides a plug member for holding back slag during the drawing-off of steel from a furnace provided with a tap hole, the plug member being a tapered body having a cross-section of multi-sided form such that the upper end part thereof is of larger cross-section than the lower end part thereof, the body being of such a size that it will fit with only the smaller end part thereof within the tap hole.

It is to be understood that the term "plug member" refers to the type of plug member whose specific gravity is such that it will "float" in the interface between molten steel and molten slag.

It is possible to construct the plug member so that the sides of the body define irregularly disposed grooves or projections extending from the upper end to the lower end of the body. However it is preferred that the body should be of generally regular sided form in cross-section. The term "regular sided form" denotes a shape where the sides are readily discernible. It is not contemplated that a body having more than twelve sides

would be utilised. It is, in fact, preferred that the number of sides should be between four and six. This multi-sided shape for the plug member ensures that there will be small passageways between the sides of the plug member and the inner wall of the tap hole even when the tapered end of the plug member has entered into the tap hole and has seated therein, so that molten metal will still run through the tap hole but to a much reduced extent.

It is preferred that the sides of the body should define either a flat or convex taper from the upper end to the lower end thereof. It is further preferred that the sides of the body should each define a flat face in cross-section although a concave face might be preferred to achieve an enhanced run off of molten metal during the final stages. Another possibility is for the sides to be distinctively convex in cross-section so as to define V-shaped grooves therebetween.

Ideally the body will have a rod projecting from the smaller end, for location of the plug member into the tap hole. This rod will ensure automatic entry of the plug member into the tap hole as the level of metal lowers within the convertor.

The invention may be performed in various ways and preferred embodiments thereof will now be described with reference to the accompanying drawings, in which:-

Figures 1 to 4 are underneath plan views of possible shapes for plug members of this invention;

Figures 5 and 6 illustrate side views of plug members constructed in accordance with the invention;  
5 and

Figures 7 to 9 are top plan views of three further plug member designs of the invention.

The plug members illustrated in Figures 1 to 4 comprise multi-sided bodies tapering from a top face 1 to a smaller lower face 2. The size of the lower face 2 is such that the lower part of the body can enter a tap hole (indicated by the dashed outline of 3) until the corners of the faces 4 of the body sit within the tap hole. Small passageways are thus defined between the  
10 faces 4 and the wall defining the hole 3.  
15

The body illustrated in Figure 1 displays four sides in cross-section while that of Figure 2 displays eight sides in cross-section. In the modified design shown in Figure 3 the cross-sectional shape of each face is concave and six faces are defined. This creates substantially larger flow passageways between the faces 4 and the hole 3. The body shown in Figure 4 has four faces with a distinct convex cross-sectional shape so as to define v-shaped grooves 5 which will provide limited  
20 run-off passageways.  
25

The plug member shown in Figure 5 is formed by a

number of flat faces 4 which define a flat taper from the top face 1 to the bottom face 2. The positioning of the plug member within the hole 3 is also illustrated and it will be seen that the plug member is provided with a projecting lower rod 6 which acts as a locating member as the plug member moves towards the hole 3 during run off of molten metal from a steel convertor. In the modified structure illustrated in Figure 6 the side faces 4 define a convex taper as shown.

10        Figures 7 and 8 illustrate plug members provided with irregularly disposed ribs 7 or grooves 8 respectively. Figure 9 shows a form of plug member where the body 9 is, in cross-section, of very irregular shape so as to define irregularly disposed channels.

15        The plug members may in addition incorporate an upwardly extending rod which may be gripped by a locating tool to introduce the plug member into a steel furnace at the required time during run off of the molten metal.



CLAIMS

1. A plug member for holding back slag during the drawing-off of steel from a furnace provided with a tap hole, the plug member being a tapered body having a cross-section of multi-sided form such that the upper end part thereof is of larger cross-section than the lower end part thereof, the body being of such a size that it will fit with only the lower end part thereof within the tap hole.

2. A plug member according to claim 1, wherein the number of sides is 4 to 6.

3. A plug member according to claim 1 or claim 2, wherein the sides of the body form a flat or convex taper from the upper end to the lower end thereof.

4. A plug member according to any one of claims 1 to 3, wherein sides of the body each define a flat or concave face in cross-section.

5. A plug member according to any one of claims 1 to 3, wherein the sides are distinctively convex in cross-section so as to define V-shaped grooves therebetween.

6. A plug member according to any one of claims 1 to 5, wherein the body is of generally regular sided form in cross-section.

7. A plug member according to any one of claims 1 to 5, wherein the sides of the body define irregularly

disposed grooves or projections extending from the upper end to the lower end of the body.

8. A plug member according to any one of claims 1 to 7, wherein the body has a rod projecting from the lower end, for location of the plug member into the tap hole.

9. A plug member for a steel furnace, substantially as herein described, with reference to the accompanying drawings.

MJ/MIO